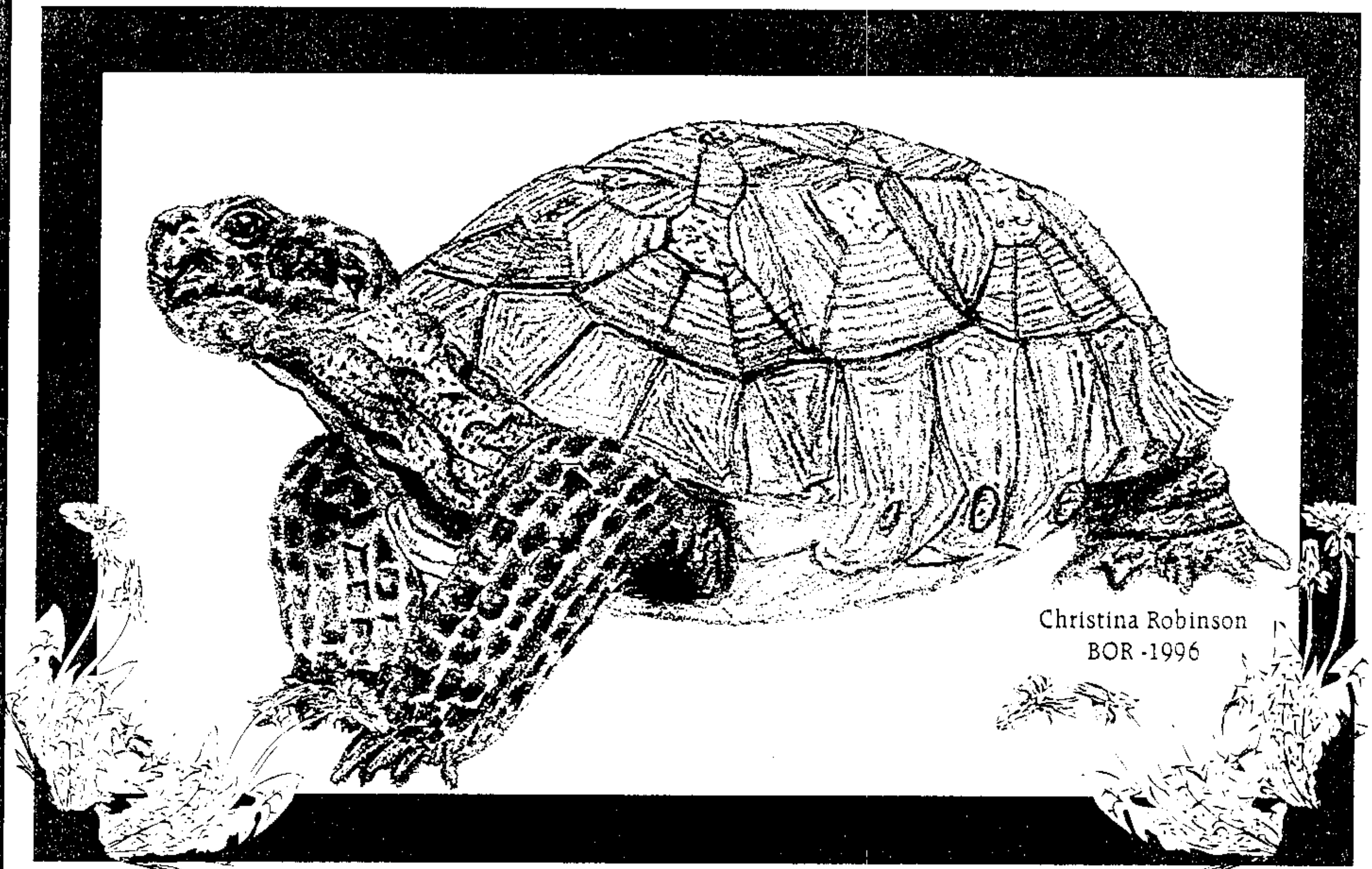
MANAGEMENT PLAN

FOR THE SONORAN DESERT POPULATION OF THE DESERT TORTOISE IN ARIZONA



Arizona Interagency Desert Tortoise Team

December 1996

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Edited by

Roy C. Murray
Nongame Branch
Arizona Game and Fish Department

and

Vanessa Dickinson
Research Branch
Arizona Game and Fish Department

PREFACE

The Arizona Interagency Desert Tortoise Team (Team) consists of biologists and managers assigned to the Team by the following agencies (alphabetically): Arizona Game and Fish Department; Arizona State Land Department; U.S. Department of Agriculture Forest Service; U.S. Department of Defense Luke Air Force Base, Marine Corp Air Station, and Yuma Proving Ground; and U.S. Department of Interior Bureau of Land Management, Bureau of Reclamation, Bureau of Indian Affairs, Fish and Wildlife Service, Geological Survey, and National Park Service. In accordance with a Memorandum of Understanding, finalized in 1995 and signed by the above agencies, the Team serves as a forum to discuss desert tortoise issues, with a specific objective to conduct and coordinate research and management efforts. This interagency cooperation is intended to: (1) ensure the perpetuation of the species and (2) prevent loss and improve quality of habitat in Arizona. This management plan is based on the best obtainable data and techniques validated by professional publication, if available. It is intended to be a dynamic document with periodic revisions as new data become available. The Team functions as an advocate for the tortoise and does not attempt to tailor recommendations to conform with the policies and practices of any agency. Each agency having responsibility for management of desert tortoise populations and habitat is encouraged to adapt this plan to meet their needs.

Many people have offered their insights and assistance in the preparation of this plan. We particularly thank Matt Alderson, Brian Bagley, Howard Berna, William Childress, Timothy Duck, David Germano, Bob Hall, Timothy Hughes, Randy Jennings, James E. May, Michelle Monroe, Deborah Noel, Bruce Palmer, Rebecca Peck, Charles Pregler, and Sabra Schwartz for their various contributions over the years. We thank David Bowman and Terry Johnson for helping organize the original team. We appreciate David Bowman, Terry Johnson, Sally Stefferud, Jay Slack, Cecil Schwalbe, and Judy Hohman's contributions as former co-chairs, as well as the participation of the following former team members: William Bayham, Sherry Barrett, Peter Bennett, Wade Eakle, Lesley Fitzpatrick, Larry Forbis, Tom Fritts, Russell Haughey, Beaumont McClure, and Ron McKown. The following contributors and team members are also gratefully acknowledged: Pablo Arroyave, Robert Barry, Bill Burger, Denise Cobb, Ted Cordery, Gene Dahlem, Todd Esque, Susanna Henry, Amy Heuslein, Dave Hoerath, Jeff Howland, Ronald Kearns, Junior Kerns, Chris Klug, Elroy Masters, Bryan Morrill, Jim Rorabaugh, Mike Ross, Paul Sawyer, Cecil Schwalbe, Dave Smith, Marty Tuegel, Stephen Williams, and Lori Young.

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

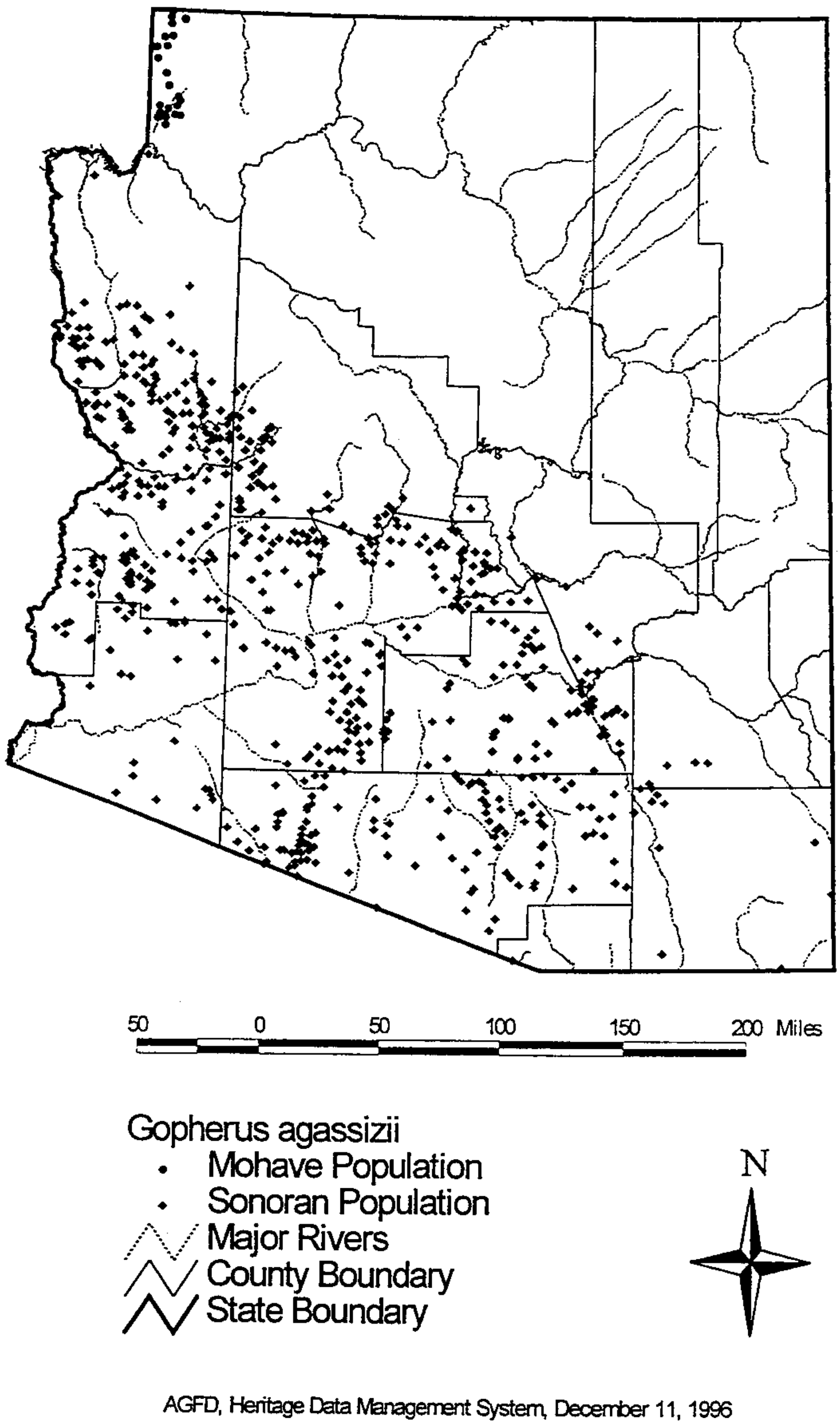
INTRODUCTION

The desert tortoise was first described by Cooper in 1863 as *Xerobates agassizii*. Bramble (1982) proposed that this species (and the Texas tortoise, *Gopherus berlandieri*) be included in the genus *Scaptochelys* based on skull and foot characters, with the genus *Gopherus* applying to the gopher tortoise (*G. polyphemus*) and Bolson tortoise (*G. flavomarginatus*). Bour and Dubois (1984) then noted that *Xerobates* had priority over *Scaptochelys*. Crumly (1994) provided phylogenetic evidence for the monophyly of the four extant species of North American tortoises and recommended the use of *Gopherus* over the paraphyletic *Xerobates*. The name *Gopherus* is used here according to Crumly's (1994) recommendation. A fifth species (*Xerobates lepidocephalus*) from Baja California is probably not a valid taxon (Crumly and Grismer 1994).

The desert tortoise ranges from southeastern California, the southern tip of Nevada and the extreme southwestern corner of Utah, through the western and southern parts of Arizona, south to northern Sinaloa, Mexico (Germano et al. 1994, Fig. 1). Genetically distinct populations are divided by the Colorado River (Glenn et al. 1990; Jennings 1985; Lamb et al. 1989; Weinstein and Berry 1988; but see McLuckie et al. 1996). On August 4, 1989, the U.S. Fish and Wildlife Service (FWS) listed the Mojave population of the desert tortoise as endangered under emergency listing procedures, giving full protection of the Endangered Species Act (ESA) to tortoises west and north of the Colorado River (FWS 1989). The Mojave population was listed as threatened under the ESA on April 2, 1990, under normal listing procedures (FWS 1990). A factor in the listing was upper respiratory tract disease (URTD) that was epidemic in some Mojave tortoise populations. Critical habitat including 836,928 ha in Arizona was designated for Mojave tortoises on February 8, 1994 (FWS 1994). In 1991, the FWS ruled that listing of the Sonoran population (south and east of the Colorado River) was not warranted (FWS 1991).

The Desert Tortoise (Mojave Population) Recovery Plan was finalized in June 1994 (FWS 1994). The recovery plan recommends establishment of 14 Desert Wildlife Management Areas (DWMAs) in six recovery units, including the Gold Butte - Pakoon and Beaver Dam Slope DWMAs, portions of which occur in Arizona. Land management in DWMAs would limit or eliminate factors such as grazing, mining, and other surface-disturbance activities that have contributed to the declining status of the Mojave population. At the time of this writing, the U.S. Bureau of Land Management's (BLM) Arizona Strip District was preparing an amendment to their Resource Management Plan to implement the Recovery Plan. The recovery plan and its companion document, Proposed Desert Wildlife Management Areas for Recovery of the Mojave Population of the Desert Tortoise (Brussard et al. 1994), detail management actions and research necessary to recover the Mojave population in Arizona. These documents and the BLM Resource Management Plan for the Arizona Strip District are the guiding documents for desert tortoise management in Arizona north of the Colorado River. Therefore, the scope of this document is primarily limited to Arizona south and east of the Colorado. Comparative information is provided in this section to highlight similarities and differences between the Mojave and Sonoran populations and to place management of the desert tortoise in Arizona within the context of rangewide species management.

Figure 1. Desert tortoise distribution in Arizona.



Many authors have reviewed desert tortoise literature (Barrett and Johnson 1990; Berry 1984; Bury and Germano 1994; Grover and DeFalco 1995; Hohman et al. 1980; Johnson et al. 1990). Since 1984, there has been an increase in agency reports and other publications on the desert tortoise. The entire proceedings of a workshop on management of the desert tortoise in California were published in *Herpetologica* (Turner 1986), and much of *Herpetological Monographs* No. 8 was dedicated to research on Mojave tortoises at the Desert Tortoise Conservation Center in Nevada (Spotila et al. 1994). Collections of papers on tortoises were published in Bury (1982), Bury and Germano (1994), and in the Proceedings of the Desert Tortoise Council Symposia (1976-95).

Description

The desert tortoise is characterized by a high-domed shell, usually with prominent growth lines on the shields of both carapace and plastron. The carapace is horn-colored or brown, often with yellowish centers in the laminae. The plastron is yellow shaded with brown along the edges of the laminae. Adult shell length ranges from about 175 to over 300 mm. The head is relatively small and rounded in front with the alveolar ridges of the upper jaws forming a sharp angle with each other. The desert tortoise has elephantine hind legs and flattened front limbs covered with large scales. Both legs and neck are retractable with limbs completely closing the anterior and posterior shell openings when withdrawn. The male tortoise has a longer tail, longer gular projections, larger subdentary glands, more thickened nails (difficult to tell in the wild), and a more concave plastron than the female. These secondary sexual differences begin to appear when tortoises reach shell lengths of between 120 and 140 mm (Grant 1936), but determination of sex is usually more accurate at about 180 mm (Burge and Bradley 1976).

Distribution and Habitat

North of the Colorado River in Arizona, tortoise populations occur in Mojave desertscrub on the western slopes of the Beaver Dam and Virgin mountains, and in the Pakoon Basin west of the Grand Wash Cliffs (Fig. 1). In the Mojave Desert and the southern end of the Great Basin Desert, the tortoise generally occurs in creosotebush (*Larrea tridentata*) flats in basins, mountain bajadas, and occasionally on rocky slopes (Berry 1984; Burge 1977*b*; Bury et al. 1994; Coombs 1977; Hohman and Ohmart 1980; Sheppard 1982; Turner et. al. 1981; Woodbury and Hardy 1948). Permanent dens are excavated in the consolidated banks of ephemeral stream channels; burrows are most often excavated in creosotebush hummocks, although some are excavated in the open or under Joshua trees (*Yucca brevifolia*) (Berry 1974; Burge 1977*a*; Hohman and Ohmart 1980; Woodbury and Hardy 1948).

South of the Grand Canyon, desert tortoises occur near Pearce Ferry in Mohave County, to the south beyond the International Boundary, and at many scattered locations in between (Fig. 1). The northeastern-most tortoise populations in Arizona are found along the Salt River near Roosevelt Lake in Gila County. The middle San Pedro River drainage in Cochise County harbors the eastern-most substantial tortoise populations, although desert tortoises have been confirmed in extreme southeastern Cochise County. Tortoises have been found as far southwest as the Barry M. Goldwater Air Force Range, Yuma Proving Grounds, and the Cabeza Prieta National Wildlife Refuge, but density appears to be lower, and distribution is less well known in southwest Arizona.

South and east of the Colorado River, desert tortoises occur primarily on rocky slopes and bajadas of Mojave desertscrub and the Arizona Upland and Lower Colorado subdivisions of the Sonoran Desert (Barrett 1990; Burge 1979, 1980; deVos et al. 1983; Ortenburger and Ortenburger 1927; Schneider 1981; Vaughan 1984). They most often occur in paloverde-mixed cacti associations (Barrett 1990; Brown 1982; deVos et al. 1983; Ortenburger and Ortenburger 1927; Vaughan 1984) but range from about 155 m in Mojave desertscrub to semidesert grassland and interior chaparral at about 1615 m (Arizona Game and Fish Department [AGFD] unpubl. data). In the Arizona Upland subdivision, boulders, outcrops, and natural cavities are important substrate components of the habitat as sheltersites. Most often, tortoises excavate burrows in deeper soils at the base of boulders and rock outcrops. Caliche caves in washes and incised, cut banks are also used for sheltersites, especially in the Lower Colorado River Valley subdivision. Sheltersites are rarely found in shallow soils. Extensive habitat and sheltersite information is presented in the monitoring plot reports listed in Table 1.

Southward into Sonora and Sinaloa, Mexico, the desert tortoise is restricted to arroyos, slopes, and bajadas in habitats ranging from brittlebush-ironwood and copal-torote associations near sea level to Sinaloan deciduous forests and Madrean evergreen oak woodlands at about 800 m elevation (Fritts and Jennings 1994; Fritts and Scott 1984; Germano et al. 1994).

Food Habits

Desert tortoises eat a variety of plants including: fresh winter and summer annual vegetation, cured annuals, plant litter, and perennial plants (Esque 1994; Jennings 1993; Luckenbach 1982; Van Devender et al. 1996); arthropods (Esque 1994; Hansen et al. 1976); bones and soil (Esque and Peters 1994; Marlow and Tollestrup 1982); and feces of vertebrates including those of tortoises (Hansen et al. 1976; Luckenbach 1982). Tortoises have been found to eat more native plants than exotics in the Mojave Desert (Esque 1994; Jennings 1993). Findings of two Sonoran and four Mojave desert tortoise forage studies are summarized in Table 2.

Several studies of seasonal foraging habits have been conducted in the Mojave Desert. Tortoises in California consumed wildflowers in spring and grasses and dried wildflowers in summer (Berry 1974). A later study found tortoises consumed forbs in the spring and switched to grasses and parts of cacti after the forbs dried out (Turner and Berry 1984). In the Mojave Desert in Arizona, studies have shown that tortoises consume forbs and annual grasses in the spring and shift to perennial grasses and cacti after the spring bloom has dried (Esque 1994; Hansen et al. 1976).

Current information on tortoise foraging habits in the Sonoran Desert is from anecdotal observations of food habits from permanent tortoise study plots (Table 1), scat analysis (Vaughan 1984), and one three-year bite count study (Dickinson et al. *in prep.*). Vaughan (1984) analyzed tortoise scat and found the major foods consumed by tortoises were forbs in spring, forbs and shrubs in summer, and shrubs in autumn. Dickinson et al. (*in prep.*) identified Sonoran tortoise food from bite count observations at two sites in north-central Arizona from March to October; tortoises fed mainly on grasses and forbs with seasonal additions of wildflowers in the spring and cacti fruit in the fall. Exotic annuals accounted for a small percentage of the total bites recorded from both sites (Dickinson et al. *in prep.*).

Table 1. Desert tortoise monitoring plots in Arizona. Plots are one square mile unless otherwise indicated. Subscripts refer to geographic localities indicated in Figure 2.

Locality	Year	Citation
Mojave Desert		
Beaver Dam Slope$_1$*	1977-80	Hohman and Ohmart (1980), Sheppard (1982)
	1989	Duck and Schipper (1989)
	1996	Goodlett et al. (1996)
Littlefield$_2$	1977-80	Hohman and Ohmart (1980), Sheppard (1982)
	1987	Duck and Snider (1988)
	1993	Rourke et al. (1993)
Pakoon Basin$_a$**	1991	Advantage Environmental Consulting (1991*a*)
Virgin Slope$_b$	1992	Advantage Environmental Consulting (1991*b*)
Sonoran Desert		
Arrastra Mountains$_c$	1987	Wirt (1988)
Bonanza Wash$_d$	1992	Woodman et al. (1993)
Eagletail Mountains$_3$	1987	Shields and Woodman (1987)
	1990	Sheilds et al. (1990)
	1991	Hart et al. (1992)
	1992	Woodman et al. (1993)
	1993	Woodman et al. (1994)
	1994	Woodman et al. (1995)
East Bajada$_4$	1990	SWCA Inc. (1990*b*)
	1993	Woodman et al. (1994)
Four Peaks$_5$***	1992	Murray and Schwalbe (1993)
	1995	Murray and Schwalbe (in prep.)
Granite Hills$_6$	1990	Sheilds et al. (1990)
	1991	Hart et al. (1992)
	1992	Woodman et al. (1993)
	1993	Woodman et al. (1994)
	1994	Woodman et al. (1995)
Harcuvar Mountains$_7$	1988	Woodman and Shields (1988)
	1994	Woodman et al. (1994)

Table 1. Continued.

Locality	Year	Citation
Harquahala Mountains$_{8}$****	1988	Holm (1988)
	1994	Woodman et al. (1995)
Hualapai Foothills$_{9}$	1991	Hart et al. (1992)
	1996	Woodman et al. (in prep.)
Little Shipp Wash$_{10}$	1980	Schneider (1981)
	1990	Sheilds et al. (1990)
	1991	Hart et al. (1992)
	1992	Woodman et al. (1993)
	1993	Woodman et al. (1994)
	1994	Woodman et al. (1995)
Maricopa Mountains$_{11}$	1987	Wirt (1988)
	1990	Shields et al. (1990)
New Water Mountains$_{e}$	1988	Shields and Woodman (1988)
San Pedro Valley$_{12}$	1991	Hart et al. (1992)
	1995	Woodman et al. (1996)
Sand Tank Mountains$_{f}$	1994	Geo-Marine, Inc. (1994)
Santan Mountains$_{g}$	1990	SWCA Inc. (1990*a*)
	1991	SWCA Inc. (1992)
Tortilla Mountains$_{13}$	1992	Woodman et al. (1993)
	1996	Woodman et al. (in prep.)
West Silverbell Mountains$_{14}$	1991	Hart et al. (1992)
	1995	Woodman et al. (1996)
Wickenburg Mountains$_{h}$	1991	Hart et al. (1992)

*500 acres.
**2 square miles.
***1 square kilometer.
****1.5 square miles.

Table 2. Desert tortoise forage species from Mojave[1] and Sonoran[2] desert studies. A=Hansen et al. 1976, B=Hohman and Ohmart 1980, C=Jennings 1993, D=Esque 1994, E=Vaughan 1984, F=Dickinson et al. *In prep.*

	A[1]	B[1]	C[1]	D[1]	E[2]	F[2]
Allionia incarnata	X					
Allium fimbriatum			X			
Ambrosia dumosa				X		
Amsinckia tessellata			X			
Argythamnia lanceolata					X	X
Aristida purpurea						X
Aristida spp.	X				X	
Astragulus acutirostris			X			
Astragulus didymocarpus			X			
Astragulus layneae			X			
Astragulus nuttallii				X		
Astragulus spp.	X				X	X
Ayenia compacta						X
Borage spp.					X	
Bouteloua aristidoides						X
Bouteloua gracilis						X
Bouteloua trifida	X					
Bromus madritensis	X	X	X	X	X	X
Cactaceae	X					
Calliandra eriophylla						X
Calycoseris parryi			X			
Camissonia boothii			X			
Camissonia palmeria			X			

Table 2. Continued.

	A[1]	B[1]	C[1]	D[1]	E[2]	F[2]
Carex spp.	X					
Caulanthus inflatus			X			
Ceratoides lanata				X		
Cercidium microphyllum					X	
Chaenactis carphoclinia			X			
Chaenactis fremontii			X			
Chorizanthe brevicornu			X			
Chorizanthe rigida			X	X		
Cryptantha circumcissa			X			
Cryptantha micrantha				X		
Cryptantha nevadensis				X		
Cryptantha spp.	X					X
Ephedra nevadensis				X		
Ephedra spp.	X					
Eriastrum eremicum			X			
Eriogonum gracillimum			X			
Eriogonum inflatum		X				
Eriogonum pusillum			X			
Eriogonum thomasii				X		
Eriogonum wrightii					X	
Eriogonum spp.	X					
Erioneuron pulchellum		X		X	X	X
Erodium cicutarium	X	X	X	X	X	X
Eurotia lanata	X	X				

Table 2. Continued.

	A[1]	B[1]	C[1]	D[1]	E[2]	F[2]
Euphorbia albomarginata			X			
Euphorbia parryi				X		
Festuca octoflora				X		X
Gambelia wizlizenii (lizard)			X			
Gilia minor			X			
Glyptopleura setulosa				X		
Hymenoclea salsola			X			
Janusia gracilis	X				X	X
Krameria parvifolia				X	X	X
Langloisia schotii			X			
Langloisia setosissima				X		
Larrea divericata		X				
Lepidium flavum				X		
Lesquerella tennella				X		
Linanthus parryae			X			
Lomatium mohavense			X			
Lotus humistratus			X			
Lotus plebeius				X		
Lotus rigidis						X
Lotus spp.		X			X	X
Lupinus odoratus			X			
Lupinus sparsiflorus		X			X	X
Lygodesmia exigua			X			
Malacorthrix coulteri			X			

Table 2. Continued.

	A[1]	B[1]	C[1]	D[1]	E[2]	F[2]
Malacorthrix glabrata			X			
Mentzelia eremophila			X			
Mentzelia spp.			X			
Mirabilis bigelovii			X			
Mirabilis spp.				X		
Monoptilon belliodies				X		
Muhlenbergia porteri	X				X	
Onethera primaverus				X		
Opuntia engelmannii						X
Opuntia spp.					X	X
Orthocarpus purpurascens						X
Oxytheca perfoliata			X			
Pectocarya recurvata				X		
Pectocarya spp.			X			
Phacelia ivesianna				X		
Phacelia tanacetifolia			X			
Pholistoma membranaceum			X			
Plantago ovata		X	X	X	X	X
Plantago patagonica				X		
Pleuraphis mutica						X
Pleuraphis rigida				X		X
Prosopis velutina					X	
Rafinesquia neomexicana				X		
Schismus arabicus			X	X	X	X

Table 2. Continued.

	A[1]	B[1]	C[1]	D[1]	E[2]	F[2]
Schismus spp.		X				
Selaginella spp.					X	
Sphaeralcea ambigua				X		
Sphaeralcea spp.	X					
Stephanomeria parryi			X			
Stephanomeria pauciflora				X		
Stipa hymenoides				X		
Strepthanthella longirostris				X		
Stylocline micropoides			X			
Thysanocarpus curvipes						X
Tridens muticus	X					
Tropidocarpum gracile			X			
Tortoise scat			X			X
Vulpia octoflora	X					

Home Range

Desert tortoise home ranges have been studied in both the Mojave Desert (Burge 1977*b*; Coombs 1977; Hohman and Ohmart 1980; O'Connor et al. 1994; Turner et al. 1981) and the Sonoran Desert (Bailey 1992; Martin 1995; Murray et al. 1995; Trachy and Dickinson 1993; Vaughan 1984), but these studies typically have small sample sizes. Vaughan (1984) found no significant differences among home range size (minimum convex polygon) of tortoises in Arizona (3-54 ha), southern Nevada (11.3-38 ha, Burge 1977*b*), the Beaver Dam Slope in Arizona (4-63 ha, Hohman and Ohmart 1980), and Paradise Canyon in Utah (12-224 ha, Coombs 1977). Trachy and Dickinson (1993) found differences in home range sizes between two sites in north-central Arizona; home ranges at Little Shipp Wash, Yavapai County, and the Harcuvar Mountains, La Paz County, averaged 22 and 8 ha, respectively. O'Connor et al. (1994) pooled data from two Mojave studies and one Sonoran study and found male home ranges to be larger than females'.

Desert tortoises make sporadic, relatively long excursions outside normal areas of activity (Sazaki et al. 1995). Some of these excursions may be for nutritional sources such as calcium mines (Marlow and Tollestrup 1982), and others may be related to seasonal movements for food and shelter. With these observations in mind, it should be noted that minimum convex polygon estimates tend to increase with the number of observations (White and Garrott 1990), so study duration should be kept in mind when drawing inferences on desert tortoise spatial requirements.

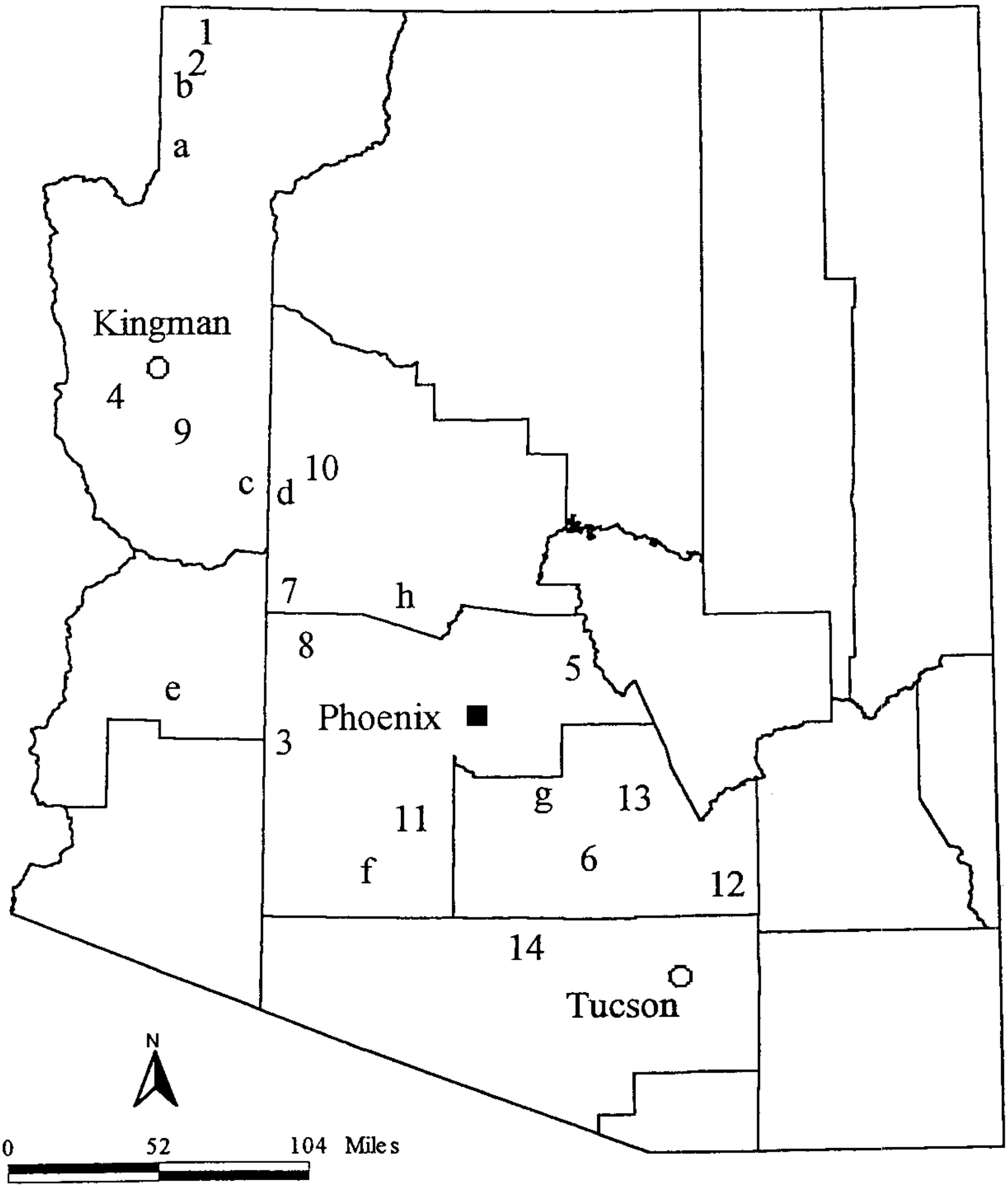
Abundance

Desert tortoise monitoring plots that have been surveyed to date are summarized in Table 1 and Fig. 2. Through 1995, 10 sites within the Sonoran Desert in Arizona had been surveyed at least twice. Abundance at nine of these sites appears to be stable or increasing; only one (Maricopa Mountains) has been observed to decrease radically in size. Indirect evidence from other populations surveyed a single time are less conclusive; several surveys have found a relatively large number of carcasses relative to live tortoises, including those at the Sand Tank Mountains (Dames and Moore, Tucson 1994; Wirt pers. comm.) and Bonanza Wash (Woodman et al. 1993). Stable population density varies greatly, ranging from about 20 to over 100 adult tortoises per square mile and appears to be related to number of available shelter sites (Hart et al. 1992; Murray and Klug 1996; Woodman et al. 1993, 1994, 1995). While URTD does not seem to be prevalent in populations studied to date, definitive causes of increased mortality at a few sites have not been identified. Potential factors include predation by feral dogs and extended drought. In addition, urban and agricultural development have resulted in loss of some populations and fragmentation or isolation of others. It should be emphasized that determining population trends from only a few points in a narrow window of time is problematic given the long life span of desert tortoises (see MONITORING AND RESEARCH NEEDS).

Current Management in the Sonoran Desert, Arizona

Several threats to tortoise populations in the Sonoran Desert have been identified, including habitat fragmentation, habitat loss and degradation from urban and agricultural development and roads, wildfires associated with invasion by non-native grasses and forbs, illegal collection, and genetic contamination of wild populations by escaped or released captives (AGFD 1996*b*).

Figure 2. Distribution of desert tortoise monitoring plots in Arizona. Plots surveyed more than once are indicated by numbers and those surveyed a single time are indicated by letters. Refer to Table 1 for plot names.



Endangered Species Act
Following the FWS ruling that the Sonoran Desert population of the tortoise did not warrant listing under the ESA (FWS 1991), the population was considered a Category 2 candidate for listing. Category 2 candidates were species for which the FWS had information indicating listing might be appropriate, but sufficient information was lacking to support a proposed rule. The Category 2 list has since been discontinued, so the Sonoran population currently has no status under the Endangered Species Act (FWS 1996). However, the FWS informally considers the Sonoran population a species of special concern.

Arizona Game and Fish Department
On January 1, 1988, the Arizona Game and Fish Commission (AGFC) prohibited the take of desert tortoises from the wild (Commission Order 43: Reptiles). Desert tortoises legally held prior to that date may continue to be possessed, transported, and propagated. Captive-bred progeny in excess of the stated limit of one desert tortoise per person may be possessed up to 24 months from date of hatching, at or before which time they must be disposed of by gift to another person or as directed by the AGFD. They may not be imported into or exported from the State or sold (AGFC 1990). The AGFD considers the desert tortoise a species of special concern (AGFD 1996*b*).

Bureau of Land Management
The BLM manages the majority of desert tortoise habitat in Arizona. BLM prepared a report in 1987 (BLM 1987) which addressed the current status of the desert tortoise and its habitat on public lands and which contains recommendations for actions needed to improve management of that habitat. A range-wide management plan (BLM 1988) and a strategy specific to BLM lands in Arizona (BLM 1990) were developed to implement those recommendations. The range-wide plan groups desert tortoise habitat into three categories according to the following four criteria: (1) importance of the habitat to maintaining viable populations, (2) resolvability of conflicts, (3) desert tortoise density, and (4) population status (stable, increasing, or decreasing). BLM's goal is to maintain viable desert tortoise populations in category 1 and 2 habitats and to limit population declines to the extent possible in category 3 habitats. The plan identifies management actions needed to implement these goals, which address environmental education, off-road vehicle use, energy and mineral development, livestock use, lands and realty actions, and other activities which may affect desert tortoises. Included is a provision to compensate for residual impacts to desert tortoises after other mitigation measures are incorporated into proposed actions. A compensation formula was developed and adopted to implement this provision (Desert Tortoise Compensation Team 1991). Habitat category maps are included in Appendix 2.

The Federal Land Policy Management Act of 1976 directed the BLM to manage public lands for multiple use and sustained yield. Wildlife is identified as one of the major uses of public lands. The Sikes Act authorizes the BLM to develop and implement plans in cooperation with State wildlife agencies for the development and protection of wildlife habitat. In response to these authorizations, the BLM has developed numerous habitat management plans which address, to varying degrees, management and conservation of the desert tortoise.

Management by other agencies

Many other local, tribal, State, and Federal agencies have management authority in desert tortoise habitat in Arizona. Lake Mead National Recreation Area, Saguaro National Park, and Organ Pipe Cactus National Monument are important habitats for tortoises. Luke Air Force Base and the Marine Corps Air Station - Yuma, in conjunction with the BLM, manage tortoise habitat on the Barry M. Goldwater Range. The Department of the Army manages Yuma Proving Grounds, which includes tortoise habitat in southwestern Arizona mountain ranges. The FWS manages tortoise habitat at the following National Wildlife Refuges: Buenos Aires, Cabeza Prieta, Havasu, Imperial, Kofa, and Bill Williams River. Tortoises may also occur at Cibola National Wildlife Refuge. Other important land owners or managers include the Arizona State Land Department; the Colorado River, Gila River, San Carlos, and Tohono O'odham tribes; the Tonto and Coronado National Forests; and Bureau of Reclamation. Through zoning and land use planning, local governments influence activities occurring primarily on private lands.

Wilderness designations

The Arizona Desert Wilderness Act of 1990 designated wilderness in desert mountain ranges on BLM lands and wildlife refuges, primarily within the range of the Sonoran population. Wilderness designations prohibit or limit many human activities that result in mortality of tortoises and habitat destruction. For example, use of motorized vehicles and equipment, mining, utility corridor construction, and other surface disturbing activities are prohibited or strictly controlled in wilderness areas. Wilderness designations at Kofa, Cabeza Prieta, Imperial, and Havasu National Wildlife Refuges, Organ Pipe Cactus National Monument, and many BLM areas, such as the Maricopa Mountains, Sierra Estrella, Swansea, and Gibraltar Mountain wilderness areas all contribute to protection of desert tortoise habitat.

MONITORING AND RESEARCH NEEDS

Monitoring

A continuing, state-wide monitoring program is of primary importance in collecting the data necessary for effective desert tortoise management in Arizona. The lack of recent, dramatic declines in tortoise abundance throughout the Sonoran Desert is encouraging relative to declines seen in portions of the Mojave Desert, but evidence of population stability in the Sonoran Desert is far from conclusive. Relatively few populations have been surveyed even two times (Table 1, Figure 2), so data to detect anything less than catastrophic population declines are completely unavailable for the Sonoran Desert. Monitoring must continue so that we may detect long-term trends, determine demographics and natural means of population regulation, and evaluate the effects of various land management practices on tortoise populations.

Several factors must be taken into consideration in implementing a monitoring program. A standard protocol needs to be developed for monitoring tortoise populations in Sonoran Desert habitats. The 60-day, square-mile plot technique described by Berry (1984) has been used in the past to monitor trends and determine other characteristics of tortoise populations, such as sex and size class ratios. However, this method was developed in flat, relatively open, Mojave Desert habitats and is not as effective in the Sonoran Desert where tortoises and sign are generally more localized and difficult to see among more complex topography and vegetation relative to the Mojave Desert (Murray 1993; Shields 1994). In developing new methods for censusing and studying tortoise populations, innovations should concentrate on efficiency, statistical reliability (including maximizing the accuracy and precision of abundance estimates and the power to detect trends), and applicability to the various size/age classes. Pathology and physiology should be used when appropriate to aid in assessing the status of tortoise populations. Monitoring should include measurements of forage production and weather conditions to determine their relationship with changes in size class distribution, growth rates, abundance, or density. Monitoring should occur range-wide (i.e., throughout the Sonoran Desert in Arizona), therefore the protocol should be designed so that inferences may be made at appropriate scales (e.g., regionally). Interagency coordination and funding commitments are necessary to provide consistent survey effort and maximize efficiency. A trend can only be demonstrated with a minimum of three points in time; many more than this will be required for robust statistical analysis. A separate Arizona Interagency Desert Tortoise Team (AIDTT) monitoring protocol will be developed to address these issues.

Research

Additional studies are also necessary to develop a more complete understanding of tortoise populations and how they respond to different land management actions. Given the longevity of desert tortoises and temporal variability in the environment, research over a long term (several decades) will provide the best information on factors affecting population characteristics. Range-wide variation should also be addressed, including conducting studies in both the Arizona Upland and Lower Colorado River Valley subdivisions of the Sonoran Desert. The funding of such studies should involve interagency cooperation and, when possible, outside support. In cases where limited agency budgets preclude long-term studies, the limited scope of inferences from one- to two-year projects should be kept in mind. Depending on study objectives relative to the monitoring program, sites for additional research projects may be adjacent to, overlapping, or otherwise associated with monitoring plots, so inferences can be related directly to abundance, density, and population trends where appropriate. The following research topics should receive funding priority depending on the management needs of particular agencies.

Population dynamics

Data on desert tortoise population dynamics are critical to understanding the causes and implications of trends in abundance. Of particular importance is the issue of habitat fragmentation and metapopulation dynamics. Population viability analyses for the Mojave population suggested that local populations of 20,000 to 60,000 animals were needed to provide reasonable assurance of persistence for 500 years (FWS 1994). The Recovery Plan recommended reserve sizes of at least 1,000 square miles in each recovery unit. Sonoran tortoise populations often occur in variable densities in isolated mountain ranges. These mountain ranges are less than 1,000 square miles in size, and local tortoise populations are probably often much less than 20,000 animals. Roads, pipelines, power lines, canals, and agricultural and urban development increasingly fragment the already patchy distribution of Sonoran desert tortoises. Effects of these factors on immigration, emigration, and extinction rates, as well as genetic relatedness and degree of isolation among local populations, need to be determined.

Only one reproduction study has been published for tortoises at a single site during a single year in the Sonoran Desert (Murray et al. 1996); additional life history data are needed to address how the relatively small local tortoise populations in Arizona persist and how they interact with other local populations in a metapopulation context. Specifically, determinants of clutch size, frequency, and success, and size-specific growth and survivorship, including temporal and geographic variations, need to be investigated. Construction of life tables for local populations is desirable, and various models should be developed using hypothetical values (based on extrapolation from available data) until specific data can be gathered. A life table would allow calculation of effects of removing tortoises of certain sizes and sexes (i.e., human collection or predation) from a population. Information on hatchling and young juvenile tortoises in Arizona habitats is essential for construction of meaningful life tables. A population viability analysis based on Sonoran population demographics and metapopulation dynamics would be valuable in assessing the vulnerability of disjunct montane populations and in calculating reserve or population sizes needed for viable populations. Additionally, information on nesting habitat, behavior, and season and factors affecting sex and size class distributions is desirable.

Habitat

Land management decisions usually affect wildlife populations indirectly through their effects on habitat; therefore, information on how desert tortoise abundance and population trends relate to their habitat is needed. Probably the two most important land management issues to be addressed are fire and grazing. The introduction of exotic annual vegetation to southwestern deserts has resulted in increased fire frequency and intensity and alteration of desertscrub communities (Medica et al. 1995; Minnich 1995). Fire can result in direct mortality of tortoises and indirect adverse effects, including temporary loss of forage, a shift in forage species, and loss of perennial plants that provide thermal cover and cover from predators (Esque et al. 1995). A perennial exotic, buffel grass (*Pennisetum ciliare*), has also spread rapidly in southern Arizona recently, especially on the east side of Saguaro National Park. The effects of this robust perennial grass on fire-sensitive Sonoran desertscrub are unknown, but they are likely to be more damaging than those of exotic annuals. Research is needed to determine the long-term effects of both wildfire and prescribed fire practices on tortoise populations and their habitats.

Grazing by cattle and sheep may result in long-term vegetation changes (Webb and Stielstra 1979), disturbance of cryptobiotic crusts (Anderson et al. 1982), elevated soil erosion and compaction (Webb and Stielstra 1979), and reduced infiltration rates (Rauzi and Smith 1973). Habitat degradation is particularly evident near water sources, where livestock congregate (Platts 1981; Szaro 1989). In the Mojave Desert, livestock have been known to trample tortoises (Coffeen 1990) and cover sites (Avery and Neibergs 1996), and construction and maintenance of range improvements can result in habitat destruction and direct mortality of tortoises. Dietary overlap between cattle and tortoises has been documented (Hohman and Ohmart 1980). Tracy et al. (1995) suggest a grazing regime that would reduce the probability of forage competition between cattle and tortoises. The Mojave population recovery plan recommends removal of livestock grazing from DWMAs (FWS 1994).

The relationship between livestock grazing and tortoises has not been studied in the Sonoran Desert, and conclusions drawn from studies of the Mojave population may not apply due to differences in vegetation communities, tortoise habitat use, grazing regimes, and other considerations. Other studies of the effects of grazing in the Sonoran Desert have shown decreases in the density of perennial grasses and shrubs (Blydenstein et al. 1957) and decreases in abundance and diversity of lizards (Jones 1981, 1988). Determining the effects of grazing would require habitat evaluations as well as long-term studies of tortoise populations in both grazed and ungrazed areas. The effects of dietary overlap, trampling, structural alteration of habitats, and creation of trails by livestock need to be addressed. Studies on the nutritional state and reproductive success of tortoises from ungrazed areas and areas grazed under various regimes are needed. In the absence of paired plots of historically ungrazed and grazed areas, the effect of adding or removing cattle from rangeland currently under various grazing regimes may be determined.

Future studies should also address the following topics in relation to their effects on habitat selection/utilization and population dynamics: sheltersite characteristics, including thermal and moisture regimes of winter and summer sheltersites; daily and seasonal activity periods and home ranges; nutritional requirements and condition; diet; nutrient content of forage species; and other physical habitat characteristics, including vegetation composition (density and diversity) and seasonal variability, elevation, slope, aspect, soil type and characteristics, and rainfall patterns. The controllable components of these requirements can then be managed to optimize desert tortoise habitat potential.

Disease

Epidemic URTD in the Mojave Desert was a factor in listing the Mojave tortoise population as threatened (FWS 1990). Signs of URTD include wheezing, runny nose, and swollen eyes and eyelids. *Mycoplasma agassizii* has been identified as the causative pathogen of URTD in the Mojave Desert (Brown et al. 1994). An enzyme-linked immunosorbent assay (ELISA) for *M. agassizii* antibodies in tortoise plasma was developed by Schumacher et al. (1993) and has been used to detect URTD on the Arizona Strip (Dickinson et al. 1995). Jacobson et al. (1991) hypothesized that habitat degradation and reductions in forage quality may be factors in the severity and spread of URTD. A shell disease (cutaneous dyskeratosis) has been associated with a population decline on the Chuckwalla Bench Area of Critical Environmental Concern, California, although the exact cause of the disease not been determined (Jacobson et al. 1994).

A five-year study of tortoise health at two sites in westcentral Arizona revealed no clinical signs of URTD (Dickinson et al. 1996), and the extremely low frequency of clinical signs reported from other populations (see references in Table 1) indicates that the disease is not epidemic in the Sonoran Desert. Cutaneous dyskeratosis has been documented in virtually every tortoise population studied in Arizona, with affected proportions ranging widely between populations (up to 67% of adult tortoises at East Bajada, Mohave County; see references in Table 1), but declines attributed to the disease have not been observed. The only tortoise population in the Sonoran Desert observed to have declined dramatically is that at the Maricopa Mountains (Shields et al. 1990). Health observations were not recorded during the first survey of this population in 1987 (Wirt 1988), but no signs of URTD were observed in 1990 (Shields et al. 1990). Local drought has been suggested as a factor in the decline, but the extent of drought at the study site has not been examined (Howland 1994).

Understanding the factors contributing to the population decline at the Maricopa Mountains is important to the management of tortoises in the Sonoran Desert, although this will be increasingly difficult to resolve as the time since the decline increases. Correlation of growth rings in perennial plants at the Maricopa monitoring plot with plants at nearby weather stations (where long-term precipitation data are available) would indicate whether drought could have played a role in that population decline (Howland 1994). Serology tests on surviving tortoises in the Maricopas may indicate whether those tortoises have been exposed to *M. agassizii*. Other research priorities relative to disease include identification to species of the URTD pathogen in tortoise nasal passages in the Sonoran Desert, spot checks for URTD in populations in which it may be expected to surface (e.g., near metropolitan areas where captive tortoises are more likely to be released), determination of the extent of URTD in the captive population in the state, and investigation of the effects of cutaneous dyskeratosis on tortoise populations.

Other research needs

Mitigation activities, including relocating tortoises on short-term, temporary development projects (e.g., pipeline and power line construction), need to be evaluated. The extent of desert tortoise distribution in extreme northwest, southwest, and southeast Arizona is poorly known.

MANAGEMENT OPTIONS

This section is not intended to be a mandatory management program that participating agencies must implement. Instead, it allows managers to select from a list of alternative methods to use in developing management prescriptions for specific areas. Not all methods are practicable for all agencies. In some cases, agencies may not have the authority to implement certain practices. Certain practices may require land use plan amendments or other administrative adjustments prior to implementation. In others, the practices listed may be ineffective in achieving tortoise habitat and population objectives, depending on conditions for a specific area. Management alternatives may be modified and improved as data from additional research become available.

Species Management

Take (collecting)

The season should remain closed on the desert tortoise until research demonstrates that tortoise populations are not at risk and it is demonstrated that take is sustainable and enforceable. Resource management agencies need to provide adequate funding for law enforcement work to minimize tortoise collecting. Also, educational programs to reduce take and increase public awareness of the desert tortoise should be implemented through AGFD, federal cooperators, and state turtle and tortoise clubs using brochures, posters, videotapes, and other media. Programs should target users of the desert, including recreationists, hunters, livestock permittees, etc.

Reintroduction, repatriation, and translocation

The concern of relocating desert tortoises into natural habitats frequently arises due to the large number of tortoises in captivity and in areas under development. Once removed from the wild, captive tortoises should no longer be considered part of the wild population. This policy is based on the following premises:

1) A tortoise develops fairly precise seasonal movement patterns for its ecological needs (Vaughan 1984). Displacement of a tortoise from its original habitat may result in an inability to find cover and nutrients at appropriate times in the yearly cycle.

2) A tortoise taken from a wild population may be exposed to diseases from other tortoises or other organisms that it is not accustomed to in its original habitat. If a diseased tortoise is returned to the wild, the infection could spread through a previously healthy population (Jacobson 1993).

3) Release of a desert tortoise at a geographic location other than its site of origin could result in genetic contamination of the local population. *G. agassizii* in the Mojave and Great Basin deserts and Sinaloan thornscrub differ genetically (Jennings 1985; Lamb et al. 1989) and have presumably evolved adaptations to these habitats, which are very different from those in the Sonoran Desert.

4) The basic question of how many tortoises a given area can sustain over the long-term is unknown. Captive releases may adversely impact a population by placing that population over the "carrying capacity" for that area.

5) Arizona law prohibits the release of any wildlife, including tortoises, without AGFC authorization.

Occasions arise where tortoises may be salvaged prior to or during large construction projects. Once removed from habitat, they should be sent into an adoption program or used for educational or scientific purposes. Until a careful research program shows reintroduction can successfully be accomplished without negatively impacting resident tortoise populations, the above policy is strongly recommended. However, tortoises may be moved into adjacent, undisturbed habitat on small-scale or short-term projects (AGFD 1996*a*; Appendix 1).

Predator control

Raven predation has been documented as a threat to juvenile and hatchling tortoises in the Mojave Desert but not south and east of the Colorado River. Topography and vegetative cover may reduce the ability of birds to prey on tortoises in the Sonoran Desert. Additionally, predator populations in these areas are not known to have increased as substantially in recent history as in other areas (BLM et al. 1989), nor are potential tortoise predators known to have significantly changed prey preferences. Predator control should be considered only on a site-specific case-by-case basis when significant predation on tortoises can be exhibited. Such control should be focused on the offending animals or populations and not on all possible predators on a broad-spectrum basis. Predator control activities for reasons other than tortoise management must be done in a manner that minimizes opportunities for impacting tortoises.

Habitat Management

Life history characteristics of long-lived organisms severely limit their ability to respond to negative population perturbations, and recovery of such populations inevitably suffers long delays (Congdon et al. 1993). Therefore, proactive management practices designed to maintain and enhance desert tortoise population levels will be more cost effective than responding to potential population declines. For example, the total estimated cost of recovery efforts for the Mojave population of the desert tortoise will exceed $16.7 million between 1994 and 1998 (FWS 1994). Other long-lived organisms (e.g., saguaros [*Carnegia gigantea*] and Gila monsters [*Heloderma suspectum*]) are associated with the desert tortoise and its habitat and may benefit from management actions for tortoises. Finally, complex interactions integrate these organisms with other members of the ecosystem, ranging from commensal occupants of tortoise burrows to nectar-feeding bats that pollinate saguaros and agaves. An ecosystem management approach is necessary to maintain the integrity of the Sonoran Desert and to preclude the need for expensive recovery efforts of individual components of this ecosystem, including the desert tortoise.

Grumbine (1994) lists five specific goals to sustain ecological integrity: 1) maintain viable populations of all native species in situ; 2) represent, within protected areas, all native ecosystem types across their natural range of variation (due to the nature of the AIDTT, this management plan addresses those ecosystems that include desert tortoises); 3) maintain evolutionary and ecological processes; 4) manage over periods of time long enough to maintain the evolutionary potential of species and ecosystems; and 5) accommodate human use and occupancy within these constraints. These goals provide a framework for the following habitat management recommendations.

Sonoran Desert Management Areas
Desert Wildlife Management Areas have been recommended within desert tortoise recovery units in the Mojave Desert (FWS 1994) and a similar recommendation for Sonoran Desert Management Areas (SDMAs) is made in this plan for the Sonoran Desert. Implementation of these management actions should benefit the entire Sonoran Desert and the relationships between component parts of this ecosystem.

Due to agency budget and personnel constraints, existing or future land use requirements, multiple use objectives, and other factors, management for the tortoise must focus on those areas with the highest value for long-term viability of the species in Arizona. To accomplish this goal, designation of SDMAs through appropriate agency procedures is proposed. Other designations or land use prescriptions may be suitable for agencies such as the National Park Service, and may be particularly suitable for certain research activities. Wilderness areas may be integral to SDMAs and management objectives and actions for desert tortoise should be compatible with their management. The various alternative management recommendations are described in more detail below.

To facilitate management, SDMAs should be designated primarily on Federal lands managed by parties to the AIDTT Memorandum of Understanding. Compatible uses and efficient and effective manageability should be considered after habitat suitability, habitat capability, and current tortoise densities when designating SDMAs. Habitat categorization, as addressed in the BLM Rangewide Plan (BLM 1988; Appendix 2) is proposed as one method for defining areas suitable for designation (Table 3). Under this proposal, only Category I and II areas would be considered for SDMA designation. However, significant areas of Category III habitat could be included to facilitate management objectives and administration of SDMAs. In contrast to the recommended minimum DWMA area of 1000 square miles (FWS 1994), and due to the tortoise's more disjunct distribution in the Sonoran Desert, SDMAs may be of smaller size. Agencies are encouraged to designate the largest areas possible depending on conditions and tortoise management objectives specific to the area. The principles of reserve design and connectivity (FWS 1994) should be exercised in SDMA design to the extent that research on habitat fragmentation and tortoise metapopulation dynamics indicates is necessary for continued persistence of local tortoise populations.

Current criteria used for categorization are broad due to a lack of knowledge about specific habitat requirements and population densities and trends. As surveys and research studies provide additional information, criteria and habitat categorization will be refined. Criteria other than those listed in Table 3 may be used to define important tortoise habitat, and other methods for SDMA determination may be developed.

Since surveys and habitat evaluations are required for designation of SDMAs, there is currently much variation in the ability of signatory agencies to define and establish them. Land management agencies should develop action plans specific to their information needs for determination and establishment of SDMAs. Action plans and SDMA designations should be coordinated with AGFD and all AIDTT cooperators to insure continuity in meeting individual population and

Table 3. Goals and criteria for three categories of desert tortoise habitat areas. The criteria are ranked by importance to the categorization process, with criterion 1 being the most important (BLM 1988).

Item	Category I Habitat Areas	Category II Habitat Areas	Category III Habitat Areas
Category Goals	Maintain stable, viable populations and protect existing tortoise habitat values; increase populations, where possible	Maintain stable, viable populations and halt further declines in tortoise habitat values.	Limit tortoise habitat and population declines to the extent possible by mitigating impacts.
Criterion 1	Habitat area essential to maintenance of large, viable populations.	Habitat area may be essential to maintenance of viable populations.	Habitat area not essential to maintenance of viable populations.
Criterion 2	Conflicts resolvable.	Most conflicts resolvable.	Most conflicts not resolvable.
Criterion 3	Medium to high density or low density contiguous with medium or high density.	Medium to high density or low density contiguous with medium or high density.	Low to medium density not contiguous with medium or high density.
Criterion 4	Increasing, stable, or decreasing populations.	Stable or decreasing populations.	Stable or decreasing populations.

overall species needs. Vegetation objectives or desired plant community descriptions should be developed for habitats in SDMAs. Management actions should be taken to achieve these objectives or desires. An example for vegetation objectives for a Sonoran Desert site was described in Cordery et al. (1993). Another example of vegetation objectives was developed for southern Nevada habitat (BLM 1990).

Forage management alternatives

Spring ephemeral forage production depends on winter/spring rainfall, and summer rainfall creates valuable late summer/fall ephemeral and perennial production. The following recommendations are based on professional judgments (often based on data from the Mojave Desert) which may change as new data are gathered. They are intended to allocate forage for the desert tortoise during the most important seasons. Cooperative efforts are needed to manage livestock on adjoining, unfenced allotments containing both Federal and State lands. Managers may select appropriate measures for SDMAs from the following range of options based on site-specific circumstances and management needs, but conservative approaches are encouraged (see references in Research Needs, Habitat).

- Exclude domestic sheep and cattle grazing.
- Ensure that wild horse and burro numbers are managed to promote a thriving ecological balance.
- Defer grazing (or rest pastures) from spring green-up, which is concurrent with tortoise emergence, through October to include peak tortoise activity (August - October) and emergence of young. The timing of green-up may vary annually depending on weather, geography, elevation, levels of livestock use, and other factors.
- Allow winter-spring ephemeral grazing only if sufficient soil moisture is present to produce and maintain a standing crop of forage plants adequate to support the number of livestock to be turned out, as well as provide for other resource values (e.g., ground cover, wildlife forage, seed source) for the entire grazing period. The determination of "adequate" should be made by an interdisciplinary team, with periodic monitoring to assure the "adequate" standard is maintained. Initial authorizations should terminate by March 31 with extensions of 30 days or less allowed only when prior determination that the forage adequacy standard described above continues to be met.
- Stock cattle only under the following criteria (Tracy et al. 1995): 280 pounds/acre (dry weight) of succulent ephemeral forage is present, consumption of forage never results in reduction of the biomass of spring annuals to levels below 54 pounds/acre, and cattle densities do not exceed those traditionally specified to protect winter forage species for domestic grazers.
- Institute vegetation use and trend monitoring studies in designated desert tortoise habitats grazed by large ungulates. Utilization of key Sonoran tortoise forage species (Table 2) should not exceed 45 percent. Key species are those important to tortoise and livestock diets that are also common enough to measure readily. Adjustments in livestock numbers, burro numbers, or other management should be made proportionately with the departure above these utilization limits.

- Exclude range improvement projects, including water developments, that would create conflicts with tortoise populations.
- Prohibit feeding of roughage, such as hay, hay cubes, or grain, to livestock as a means to supplement forage quantity.
- Exclude livestock grazing for at least one growing season after a fire.
- Manage rangelands to increase density and distribution of native perennial grasses.

Surface management alternatives
The following range management alternatives are designed to minimize impacts to desert tortoise populations through direct loss of tortoises or their habitat. Surface-disturbing activities should generally be discouraged, but managers may select appropriate measures for SDMAs from the following range of options based on site-specific circumstances and management needs.

- Subject to valid existing rights, withdraw SDMAs from mineral entry.
- Evaluate sales of mineral materials (especially boulders) and vegetation. Prohibit sales which negatively impact desert tortoises or their habitat.
- Evaluate oil, gas, and geothermal lease areas and stipulate protective measures for tortoise habitat, which can include areas of no surface occupancy.
- Confine the period of leasable mineral exploration and major construction work to the periods November 1 - March 1.
- Minimize surface-disturbance associated with authorized activities. Perform complete preconstruction inspections of areas to be developed and mitigate actions to protect tortoises and their habitat, including reclamation and bonding if appropriate.
- Limit seismic exploration, new construction, road maintenance, vehicle use, or other surface-disturbing activities to existing rights-of-way.
- Prohibit competitive motorized speed events.
- Limit vehicular travel and non-motorized competitive events to designated routes.
- Close and rehabilitate existing roads where no public or administrative need exists.
- Follow fire suppression guidelines as outlined in Duck et al. 1995 (Appendix 3).
- Require erection of tortoise barriers around projects that would be sources of mortality (i.e. canals, heavily-used roads, steep-walled reservoirs) and promote methods that allow movement across such projects. Barriers should be constructed of hardware cloth or welded wire mesh with a mesh size of no greater than 1 inch (horizontal) by 2 inches (vertical) securely fastened to and supported by posts adequate to maintain the integrity of the fence. The barrier should extend at least 18 inches above the ground and 12 inches below the surface. Where burial of the fence is not possible, the lower 12 inches should be folded outward and fastened securely to the ground to prevent desert tortoise entry. Any gates through the fence should be kept closed and designed so tortoises cannot enter. The fence should be inspected at least quarterly and maintained as needed. Other suitable materials with a mesh as suggested here may be used as temporary fencing around sites in which disturbance would be short term, such as temporary equipment staging areas or during pipeline construction.

Spatial considerations
The following management alternatives are designed to maximize the conservation value of SDMAs by protecting areas large enough to support viable populations of desert tortoises. Managers may select appropriate measures for SDMAs from the following range of options based on site-specific circumstances and management needs.

- Compensate for residual project impacts in accordance with the Desert Tortoise Compensation Team (1991) (Table 4).
- When possible, prohibit activities that would fragment or further isolate existing populations of desert tortoises (i.e. canals, highways) within or between SDMAs. Retain links of habitat suitable for tortoise use between SDMAs.
- Retain desert tortoise habitat in SDMAs presently in public ownership unless disposal through an exchange provides greater benefits to tortoises.
- Acquire lands or obtain conservation easements from willing sellers on inholdings within SDMAs. Manage acquired habitat in perpetuity for the protection and enhancement of the desert tortoise and its habitat.

Conclusion
Implementation of the methodologies for management mentioned here should stabilize, and in many cases alleviate, pressures on the desert tortoise and its habitat. As research addresses existing data gaps, further steps can be developed to improve the status of the desert tortoise in Arizona.

Table 4. Description of factors used to compute compensation rates for residual impacts (modified from Desert Tortoise Compensation Team 1991).

Code	Factor	Value
C	Category of habitat:	
	a) The lands are in Category III desert tortoise habitat	*
	b) The lands are in Category II desert tortoise habitat	2
	c) The lands are in Category I desert tortoise habitat	3
T	Term of effect:	
	a) The effects of the proposed action are expected to be short term (< 10 years)	0
	b) The effects of the proposed action are expected to be long term (> 10 years)	1
E	Existing disturbance on site:	
	a) There is moderate to heavy existing habitat disturbance	0
	b) There is little or no existing habitat disturbance	1
G	Growth inducing effects:	
	a) The proposed action will have no growth inducing effects	0
	b) The proposed action will have growth inducing effects	0.5
A	Adjacent habitat impacts:	
	a) Adjacent habitat will not be affected	0
	b) Adjacent habitat will receive direct or indirect deleterious impacts	0.5

Compensation Rate = C + T + E + G + A

Range of Rates:	Category I:	3 - 6
	Category II:	2 - 5
	Category III:	1

* Category III habitats receive a Compensation Rate of 1 only (see discussion in text).

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APPENDICES

APPENDIX 1

GUIDELINES FOR HANDLING SONORAN DESERT TORTOISES ENCOUNTERED ON DEVELOPMENT PROJECTS

Arizona Game and Fish Department

Revised January 17, 1997

The Arizona Game and Fish Department (Department) has developed the following guidelines to reduce potential impacts to desert tortoises, and to promote the continued existence of tortoises throughout the state. These guidelines apply to short-term and/or small-scale projects, depending on the number of affected tortoises and specific type of project.

Desert tortoises of the Sonoran population are those occurring south and east of the Colorado River. Tortoises encountered in the open should be moved out of harm's way to adjacent appropriate habitat. If an occupied burrow is determined to be in jeopardy of destruction, the tortoise should be relocated to the nearest appropriate alternate burrow or other appropriate shelter, as determined by a qualified biologist. Tortoises should be moved less than 48 hours in advance of the habitat disturbance so they do not return to the area in the interim. Tortoises should be moved quickly, kept in an upright position at all times and placed in the shade. Separate disposable gloves should be worn for each tortoise handled to avoid potential transfer of disease between tortoises. Tortoises must not be moved if the ambient air temperature exceeds 105 degrees fahrenheit unless an alternate burrow is available or the tortoise is in imminent danger.

A tortoise may be moved up to two miles, but no further than necessary from its original location. If a release site, or alternate burrow, is unavailable within this distance, and ambient air temperature exceeds 105 degrees fahrenheit, the Department should be contacted to place the tortoise into a Department-regulated desert tortoise adoption program. Tortoises salvaged from projects which result in substantial permanent habitat loss (e.g. housing and highway projects), or those requiring removal during long-term (longer than one week) construction projects, will also be placed in desert tortoise adoption programs. *Managers of projects likely to affect desert tortoises should obtain a scientific collecting permit from the Department to facilitate temporary possession of tortoises.* Likewise, if large numbers of tortoises (>5) are expected to be displaced by a project, the project manager should contact the Department for guidance and/or assistance.

Please keep in mind the following points:

- These guidelines do not apply to the Mohave population of desert tortoises (north and west of the Colorado River). Mohave desert tortoises are specifically protected under the Endangered Species Act, as administered by the U.S. Fish and Wildlife Service.

- These guidelines are subject to revision at the discretion of the Department. We recommend that the Department be contacted during the planning stages of any project that may affect desert tortoises.

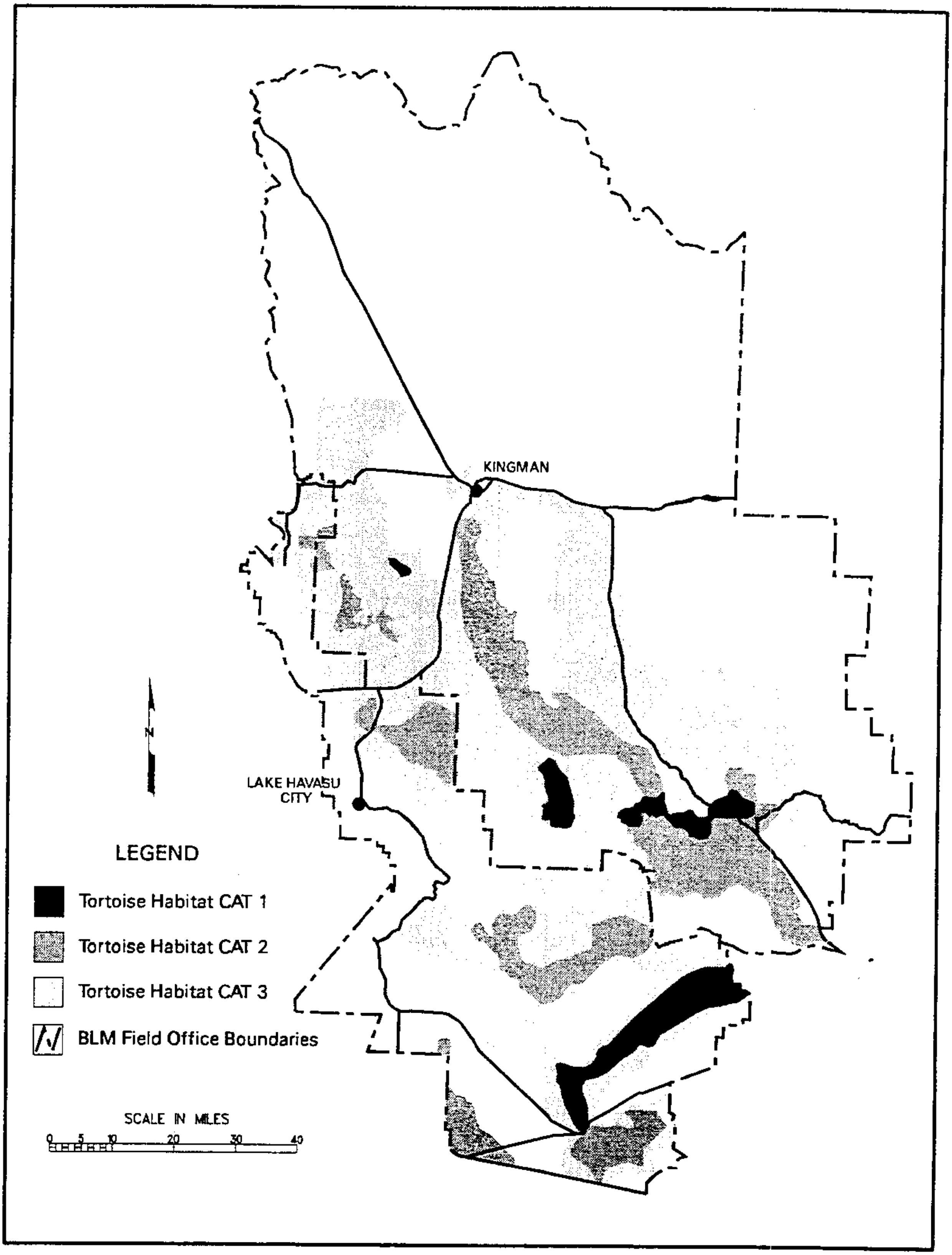
- Take, possession, or harassment of wild desert tortoises is prohibited by state law. Unless specifically authorized by the Department, or as noted above, project personnel should avoid disturbing any tortoise.

RAC:NLO:rc

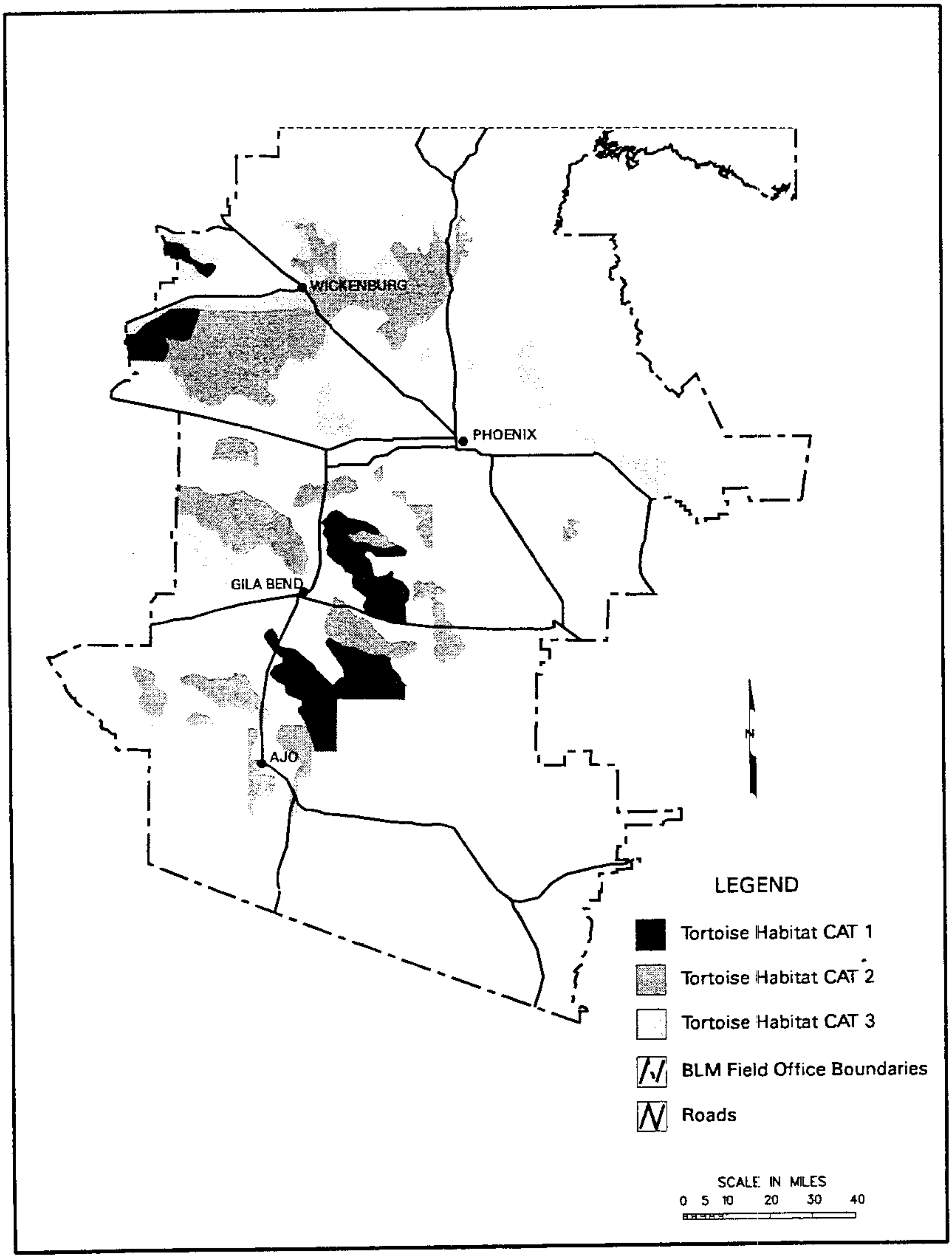
APPENDIX 2

BLM Desert Tortoise Habitat Category Maps

BLM TORTOISE HABITAT - KINGMAN / LAKE HAVASU



BLM TORTOISE HABITAT - PHOENIX FIELD OFFICE (SOUTHERN PART)



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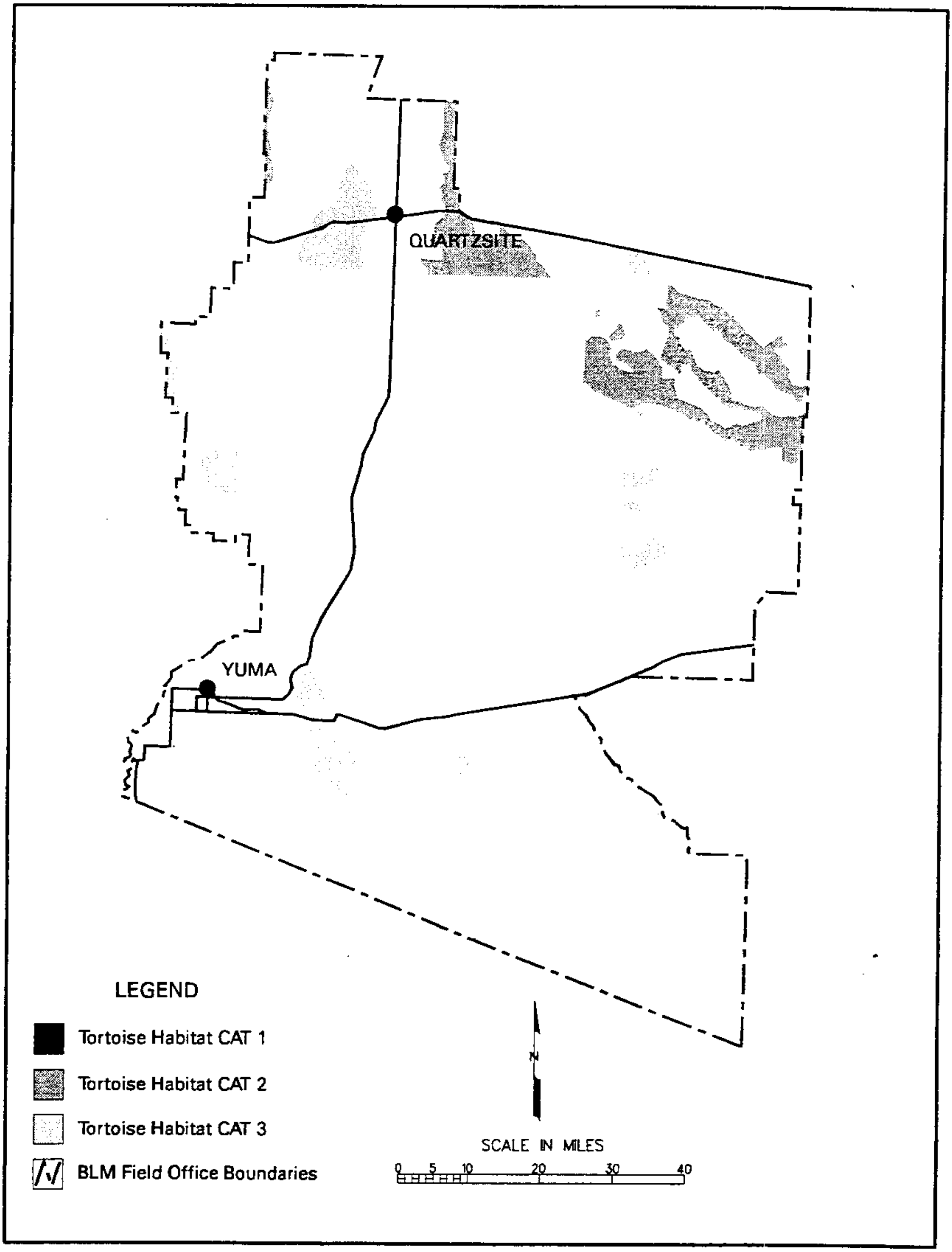
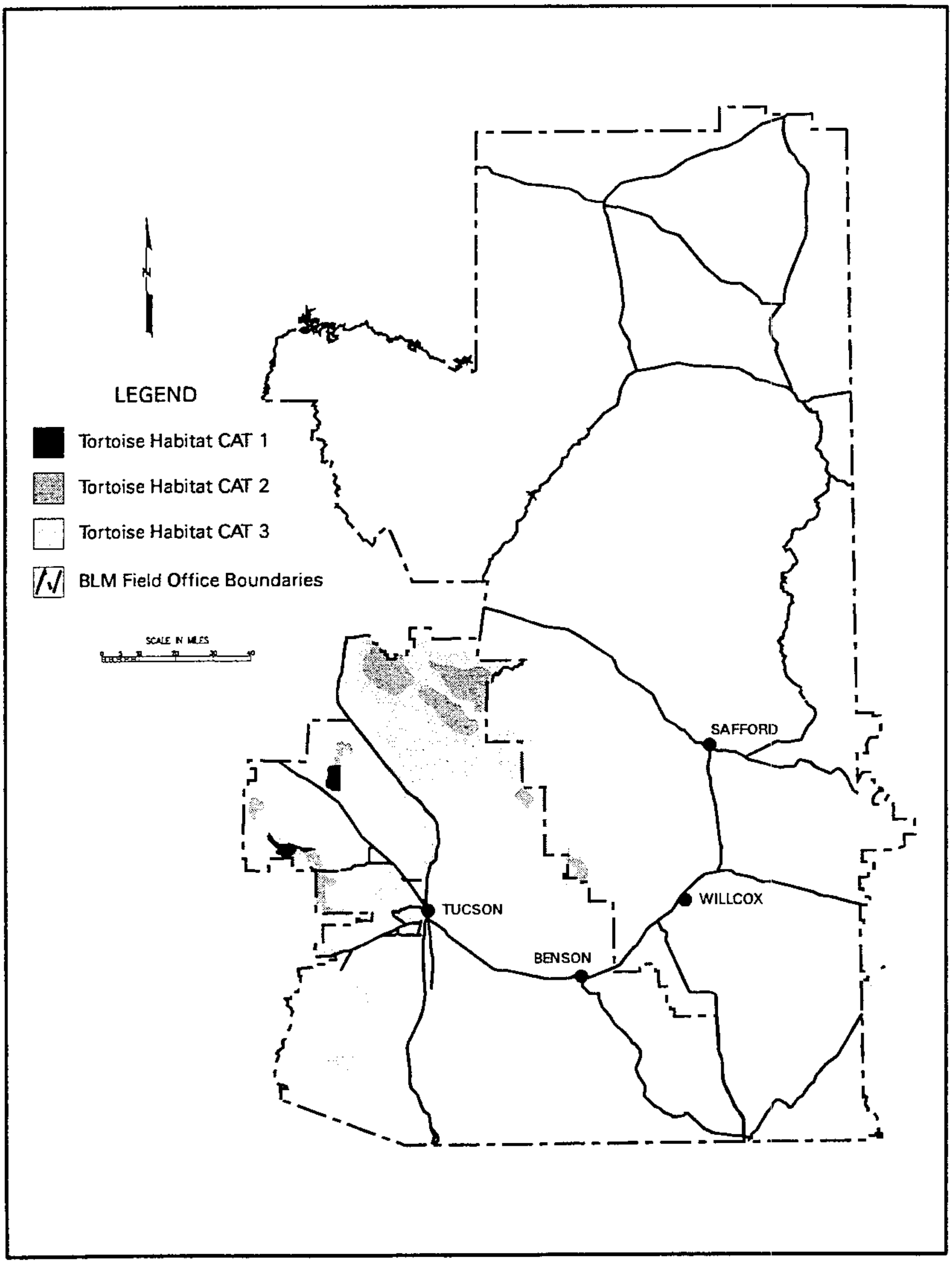


BLM TORTOISE HABITAT - TUCSON / SAFFORD



APPENDIX 3

Fighting Wildfire in Desert Tortoise Habitat: Considerations for Land Managers

Timothy Allen Duck, Todd C. Esque, Timothy J. Hughes

Modified from the Proceedings of the 1994 Symposium of the Desert Tortoise Council

FIGHTING WILDFIRE IN DESERT TORTOISE HABITAT: CONSIDERATIONS FOR LAND MANAGERS

Timothy Allen Duck, Todd C. Esque, Timothy J. Hughes

Wildfires have the potential to drastically alter desert landscapes, reducing their ability to support wildlife. Until advances in fuel management provide tools to reduce fire occurrence and intensity, suppression remains our best response. However, there are risks associated with suppression activities. Vehicles create tracks that can become trails for civilian off-road vehicle enthusiasts, and can crush tortoises or their nests or burrows. In the interest of conserving habitat for tortoises and other desert wildlife it is useful to predict years of high fire incidence and prepare resource advisors and firefighters for the special considerations of suppressing fires in tortoise habitat. Through this cooperative approach it is possible to resolve the conflicts that may arise from wildfire suppression.

Fire management begins during the winter when those who are responsible for habitat management meet with fire specialists to develop a policy, identify areas of concern (such as desert wildlife management areas, research plots, critical habitat, etc.), discuss objectives and restrictions, and determine levels and methods of fire suppression in an attempt to get all parties to a common understanding of the situation prior to the start of fire season. Appendix 1 contains a list of considerations.

In this meeting fire management personnel develop an understanding of the importance of quick, effective action, and biologists become aware of the tactical and logistical considerations of firefighting. A tortoise education program and shift briefing is developed.

During the fire season biologists are on call, available to respond to a fire in necessary. These individuals must receive basic firefighter training and have the necessary protective clothing and equipment in order to be able to go out on the fireline.

Local fire crews receive a desert tortoise education program during their regular early season fire training. Biologists may need to attend this training to become fire qualified. Firefighters receive information specific to the agency that where they work, similar to the information contained in Appendix 2. It is crucial that firefighters understand how their actions can impact the environment and how they can reduce those impacts.

Throughout the year the Fire Management Officer monitors fuels and weather and reacts accordingly by increasing or decreasing forces, prepositioning equipment, etc.

Suppression techniques were developed for forest fires, and some modification may be appropriate for desert conditions. The Incident Command system is the standard management structure used by state and federal agencies. It is a strictly regimented command and control system where everyone has a defined role.

The Incident Commander (IC) directs several subfunctions; the two we are most concerned with are Operations and Logistics. The Resource Advisor provides input directly to the IC. On small fires the IC may be a local fire crew foreman. On larger fires, an incident management team may be brought in. Sometimes these teams have little or no experience working in the desert. These teams receive their mandate from the local agency manager, and it is imperative that the importance of the mission and the importance of the tortoise mitigation guidelines be conveyed from the agency manager to the IC, who is responsible for relaying that information and emphasizing its importance to his subordinates.

Logistics people set up a support organization that can impact tortoises and their habitat in a variety of ways. The location and design of camps, and any rules of behavior, are important considerations. Biologists work with Camp Managers to identify camp areas, which should be inventoried and all sheltersites flagged. The best situation is one where all camp activities are contained within a previously disturbed area. Establishing rules of conduct - such as setting certain areas off-limits - can further reduce impacts.

The other main logistical function is Ground Support. Work with them to establish rules for vehicles - travel restrictions, parking, speed limits. In a fire situation, may persons tend to hurry, and by informing them of the presence of tortoises and driving rules, we can reduce tortoise/vehicle encounters. We go so far as to tell drivers how to park and turn around on desert roads with a minimum of impact.

The real action is in Operations, where firefighters attempt to halt the spread of the fire. We use hand crews to build and hold line, or to hot spot, and support them with engine crews. Engine can patrol roads or lay hose along fire lines. If necessary, engines can go off-road, preceded by a monitor or firefighter on foot. We use local units to go off-road first rather than imported units due to the local units high level of knowledge about tortoises and their familiarity with guidelines. We ask that fire crews obliterate the first 50 to 100 feet of their tracks in areas of high off-road vehicle abuse to reduce the temptation of the public to drive down those tracks.

Desert wildfires can, under high fuel loads or during high winds, move very fast and present difficult control problems. These problems are exacerbated when suppression forces are insufficient to meet the need, so we also use aircraft such as helicopters and airtankers for a variety of missions. Helicopters can transport personnel into roadless areas, provide a reconnaissance platform, and deliver water from buckets. Historically large, surplus military bombers, airtankers are evolving toward small, single-engine aircraft that can work from dirt landing strips, reducing turnaround time. al aircraft landing and fueling areas must within habitat must be cleared prior to use to minimize opportunities for take.

There are several options for retardant - foam, water, slurry - we prefer a fugitive retardant slurry over water, foam, or the traditional iron oxide phosphate retardant slurry. Retardant is most effective when ground forces are present to come in and secure the area.

Sometimes we fight fire with fire. Under certain conditions the best, perhaps only opportunity to contain a fire is to set backfires along control lines to remove fuel. This is a risky endeavor. Because of the intensity of backfires, the areas where they are attempted can be the most denuded. However, under high wind conditions, or high fuel loads, roads and handlines, even those held by fire crews, will not even slow a fast-moving fire. In some circumstances, backfiring is used to protect a larger area.

Fires burn erratically, leaving patches of unburned fuel called islands or fingers. Traditional fire suppression techniques call for the "burning out" of these unburned areas to reduce the chance of the fire flaring up and making a run at control lines. However, in desert habitats these islands and fingers are not as much of a threat as they are in timber fires, and due to their value as undisturbed habitat in a sea of burn we do not allow "burning out".

We have included tracked vehicles in our suppression force mix, but due to their long-lasting impacts on desert soils and vegetation they are used only as a last resort, to improve roads or construct line where a short distance of line might save a large area from fire. We have not used tracked vehicles since 1980. Due to slow response times, we have allowed tracked vehicles to be ordered and staged nearby, facilitating their use should the decision to use them be made. Tracked vehicles must be preceded by a qualified monitor.

There are two levels of involvement of biologists in fire suppression; as the Resource Advisor who provides input to the IC and as a monitor who clears sites, accompanies equipment off-road, or simply observes activities.

Monitors work directly with fire crews and support personnel to ensure that guidelines are followed and impact minimized. Monitors ensure that tortoises and their habitat are protected from specific suppression actions but do not direct suppression efforts.

Resource Advisors provide information and guidance to the command staff and act as liaison between the IC and the agency manager. Resource Advisors do not set specific control objectives or determine tactics - those are the responsibilities of the firefighters. It is essential that biologists do not give conflicting orders in potentially dangerous situations - work through the chain of command. Most firefighters are more than willing to comply with guidelines.

Appendix 1. Fire Suppression Activities in Desert Tortoise Habitats.

Preseason

Resource Manager meets with Desert Tortoise Biologist and Fire Management Officer.

Identify areas of concern (maps of Critical Habitat/BLM Habitat Categories/Research or Study Areas).

Determine level and methods of suppression. Full suppression of desert wildfire requires quick initial attack by hand crews, engines, and aircraft. Plan for sufficient number of crews and engines; consider contract helicopter and single engine air tanker.

List key contacts.

Discuss objectives of fire suppression.

Discuss restrictions on fire suppression.

Identify water sources and arrange for their use.

Identify locations for base camp and staging areas and survey them for tortoise.

Determine locations of natural and man-made barriers to fire.

Conduct annual road maintenance just prior to fire season; improves access and creates barriers to fire.

Fire Season

Tortoise Biologist/Resource Advisor on call 24 hours. Must be qualified and equipped to go out on fire line (issued full protective gear and provided with basic firefighter training course).

Local fire suppression forces are briefed on desert tortoise considerations for fire suppression during their regular early season fire training. Includes discussion of tortoise ecology, legal status, fire suppression goals and restrictions.

F.M.O. monitors fuel load and weather conditions and adjusts initial attack preparedness level according to fuel and weather.

Fire Suppression

Fire suppression is a dangerous business. Tortoise considerations are crucial but secondary to issues of human safety. Fire organization is strict chain-of-command. Resource advisor helps define goals and objectives for suppression effort and informs I.C. of any restrictions, but does not get involved in specific suppression tactics. Tortoise biologist/monitors ensure tortoises and sheltersites are protected/avoided but do not give specific directions on line location.

It is important that biologists not interfere in fire suppression operations. Provide input and assistance. If tortoise considerations are not being observed, discuss with I.C. and F.M.O. Don't jump into hot situation and give conflicting orders.

Small fires handled by local forces.

For more complex fires, an organized fire management team is brought in. The Incident Commander informed by Resource Manager that tortoise considerations have high priority. I.C. relays through subordinates the importance of following the guidelines. Resource advisor speaks at shift briefings (Appendix 2).

I.C. and resource advisor evaluate suppression resources, tortoise habitat and population considerations, develop plan for suppression.

Use hand crews to build and defend fire line. Engines support from roads. Wherever practical, engines remain on road and lay hose along hand line. If engines need to go off-road then they must have crewperson or biologist walking in front of engine to avoid tortoises and sheltersites. Use local units to go off road first.

Hot fires may require aerial support from helicopters or airtankers using slurry (fugitive retardant most preferred, iron oxide least preferred), foam, or water retardants.

If it appears that it may be necessary to use tracked vehicles then order and stage them at a cleared site - use as last resort where short distance of cat line will prevent large area from burning. Tracked vehicles must be accompanied by qualified biologist/monitor.

Backfire from roads or lines where necessary. Do not burn out fingers or islands - scratch line and patrol.

Order additional suppression forces for any private land/property protection.

Post Suppression

Notify appropriate agencies of any take of any listed species.

Begin rehabilitation of fire lines, especially cat lines. Obliterate vehicle tracks that leave roads to prevent those tracks from becoming trails and roads.

Begin any rehabilitation of burned area - seeding, etc.

Begin vegetation monitoring. Establish paired plots inside/outside burn.

Conduct post-fire critique. Evaluate effectiveness of suppression activities and identify successes and failures of desert tortoise mitigation efforts. Revise procedures as necessary.

Appendix 2. Shift briefing for fire suppression foreces working in desert tortoise habitats.

INTRODUCTION

Key points and issues: Firefighters are busy folks but they need to know that tortoise habitat is a priority; Firefighters who are used to working in timber may not see the value of desert resource; some ecosystems depend on fire while Mojave is not fire-tolerant; invasion of exotic grasses converting desert habitat. Ecosystem management responsibilities. Effects on tortoise.

This fire is burning in the habitat of desert tortoises, a species listed as threatened with extinction by the U.S. Fish and Wildlife Service. Critical Habitat/ Desert Wildlife Management Area discussion.

Heat and smoke can kill or injure tortoises and destroy eggs. Mojave Desert shrubs are not fire-tolerant, and the loss of shrubs decreases cover for tortoises, making them more exposed to the sun and predators. The short-term loss of forage is followed by an invasion of exotic annual grasses. The post-fire vegetation has a lower species diversity than the natural community. Fewer species mean less choice. In a monotypic stand of red brome, all plants green-up and cure out at the same time, creating a window of feeding opportunity where before the wide variety of plants provided more feeding options. The nutritional value of any one species is less desirable than the combination of several plant species.

The grass regeneration cycle is shorter than the shrub cycle, so before the native vegetation can reestablish the exotic grasses burn once more, usually spreading into previously unburned areas. The conversion grows like cancer.

Our agency is responsible for conserving the habitat and recovering tortoise populations. To that end we are managing all human activities such as grazing, mining, and off-road vehicles in a restrictive manner. It is a priority for us to reduce the degradation of habitat from wildfire. Tortoise is not only consideration - our agency is responsible for managing ecosystems - many resource values (list local emphasis).

TORTOISE FACTS

Key points and issues: describe tortoises and sheltersites so that firefighters can recognize and avoid. As time permits, add any interesting facts or stories.

Describe desert tortoise sheltersite types - burrows, dens, and pallets - their shapes and locations. Describe desert tortoises - color, size, and shape - and any local characteristics that would help novice see tortoise. Use photos, diagrams, handouts, models.

OPERATIONAL APPROACH

Key points and issues: Overall goal to fight fire safely and efficiently, minimizing size and impacts of suppression activities. Relationship of biologists to command. Strategy.

The overall goal of this fire suppression effort is to safely and efficiently minimize fire size and the impacts, such as take of threatened or endangered species, from suppression actions. Take is defined by the Endangered Species Act as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or to attempt to engage in any such conduct. The Resource Advisor will brief the I.C. on tortoise considerations and advise on preferred strategies. I.C. has the authority to take actions that are deemed appropriate to ensure safety of firefighters and public, reduce threats to equipment and private property.

Tortoise monitors will be assigned, where necessary, to work directly with units. On the line, monitors have the authority to direct crews to avoid tortoises and their nests and sheltersites, but will not direct the suppression action. When working with support units, monitors have authority to ensure avoidance of tortoises and their nests and sheltersites when developing base camp facilities and staging areas. Use of predetermined and inventoried areas is encouraged.

Resource Advisor and tortoise monitors will work through the chain of command to accomplish their mission. It is inappropriate for them to give conflicting orders directly to personnel in the field.

In order to minimize habitat disturbance and the chance of take from suppression action we recommend the following strategy:

> Simultaneous use of hand crews to construct and hold fire line, engines to hold roads and lay hose to support hand crews, and aerial retardant from airtankers (either large tankers or single engine air tankers) and helicopters. Fugitive retardant preferred over iron oxide.
>
> Where necessary, engines can go off road, preceded by a crewperson, ensuring the vehicle does not crush any tortoises, nests, or sheltersites.
>
> If it appears that it may be necessary to use tracked vehicles then order and stage them at a cleared site - use as last resort where short distance of cat line will prevent large area from burning. Tracked vehicles must be accompanied by qualified biologist/monitor. Rehabilitate cat lines completely.
>
> Backfire from roads or lines where necessary. Do not burn out fingers or islands - scratch line and patrol. These islands and fingers become essential habitat features.
>
> Order additional suppression forces for any private land/property protection.

RESTRICTIONS

Minimize off road travel. Wheeled vehicles will be preceded by crewperson to observe, tracked vehicles require qualified monitor. On road travel restricted to speeds that allow driver to identify if lump in road is a rock, tortoise, or cow pie. Minimize disturbance at turn-around points. After fire, obliterate all vehicle tracks from point where they leave road out 50 to 100 feet to prevent that track from attracting future vehicle use.

Firefighters should note location and condition of desert tortoises and carcasses, but should not attempt to touch or move unless the animal is in immediate danger from fire or is on a road that is receiving traffic. Provide notes to tortoise biologist/ resource advisor.

Firefighters will not leave trash on the line. Around camp, trash receptacles will be available and emptied regularly.

QUESTION AND ANSWER PERIOD